BULLETINS AND PAPERS

RELATING TO THE

INCANDESCENT GAS LIGHTING INDUSTRY

MANUFACTURING FACILITIES

(First Paper)

SCOVILL PLANT

Burners, Arc Lamps and Metal Parts

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OF THE

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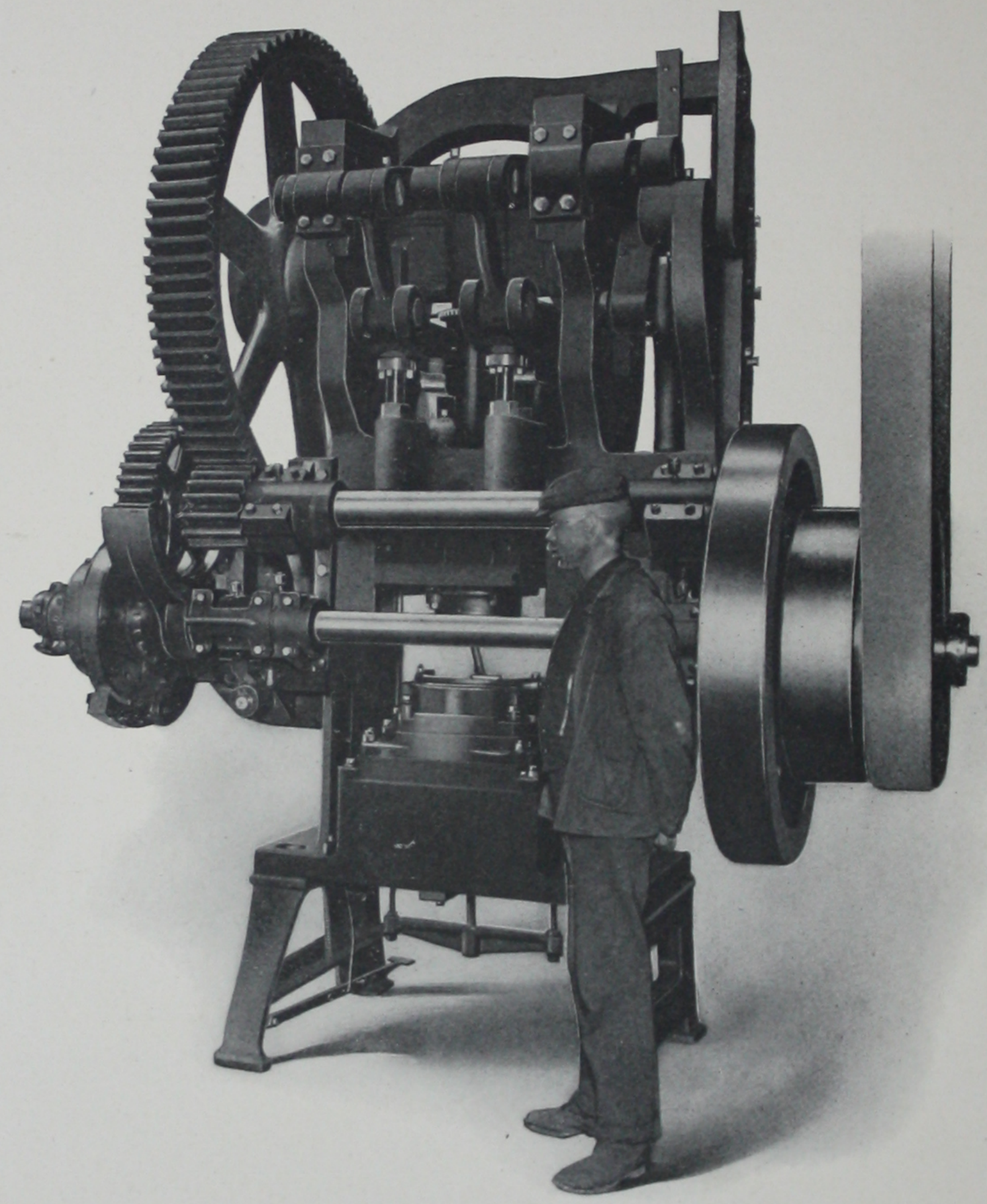


GIANT PRESS FOR DRAWING ARC LAMP STACKS

MANUFACTURING FACILITIES

(FIRST PAPER)

INTRODUCTION

THE Scovill Manufacturing Company, of Waterbury, Connecticut, established in 1802, one of the largest producers of brass and brass goods in the United States, makes practically all the metal goods used by the Welsbach Company. A working relation has existed for the past fifteen years between these Manufacturing Companies, and as a result a special department has been formed for handling this work under an independent, highly developed and specially trained organization.

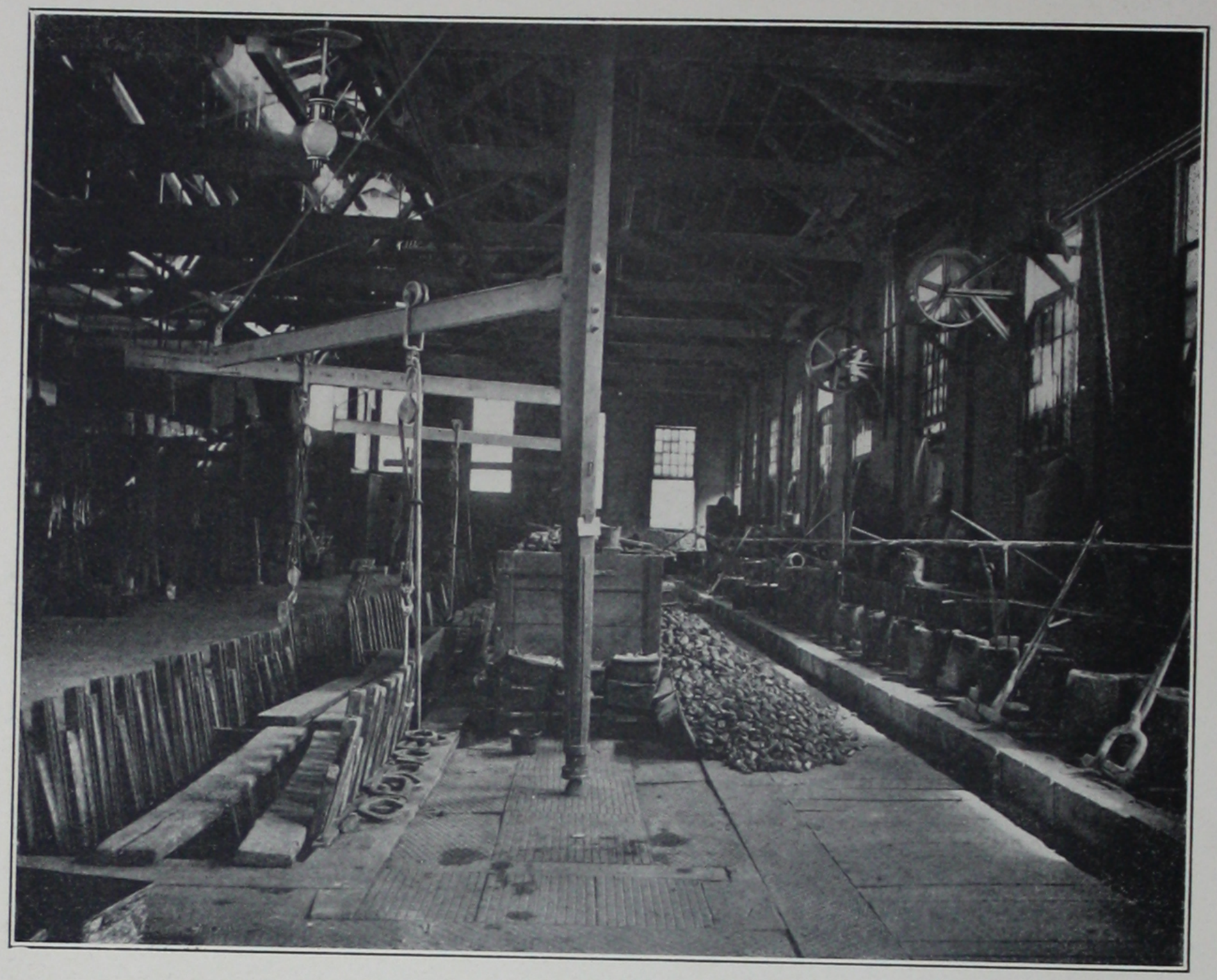
The annual production of Welsbach burners, mantle carriers and mantle supports aggregates many millions, and several hundred thousand of the more complicated lighting appliances, such as arc lamps, heavy metal parts, etc., are manufactured every year.

This pamphlet is not in any sense intended as a complete description of the Scovill Manufacturing Company's plant or its methods of manufacture, as the goods made for the Welsbach Company are only a small percentage of its total volume of business; but it will give an outline of the various processes through which a Welsbach burner passes, and an idea of the highly perfected facilities at hand for the manufacture of these very important commercial products.

THE MANUFACTURE OF THE WELSBACH BURNER.

While this paper treats primarily of the manufacture of the Welsbach burner, yet the processes which are employed may be applied as well to other articles made for the Welsbach Company, with minor modifications, depending on the character of the goods and materials used. In general we can group the operations, making the complete process as follows:

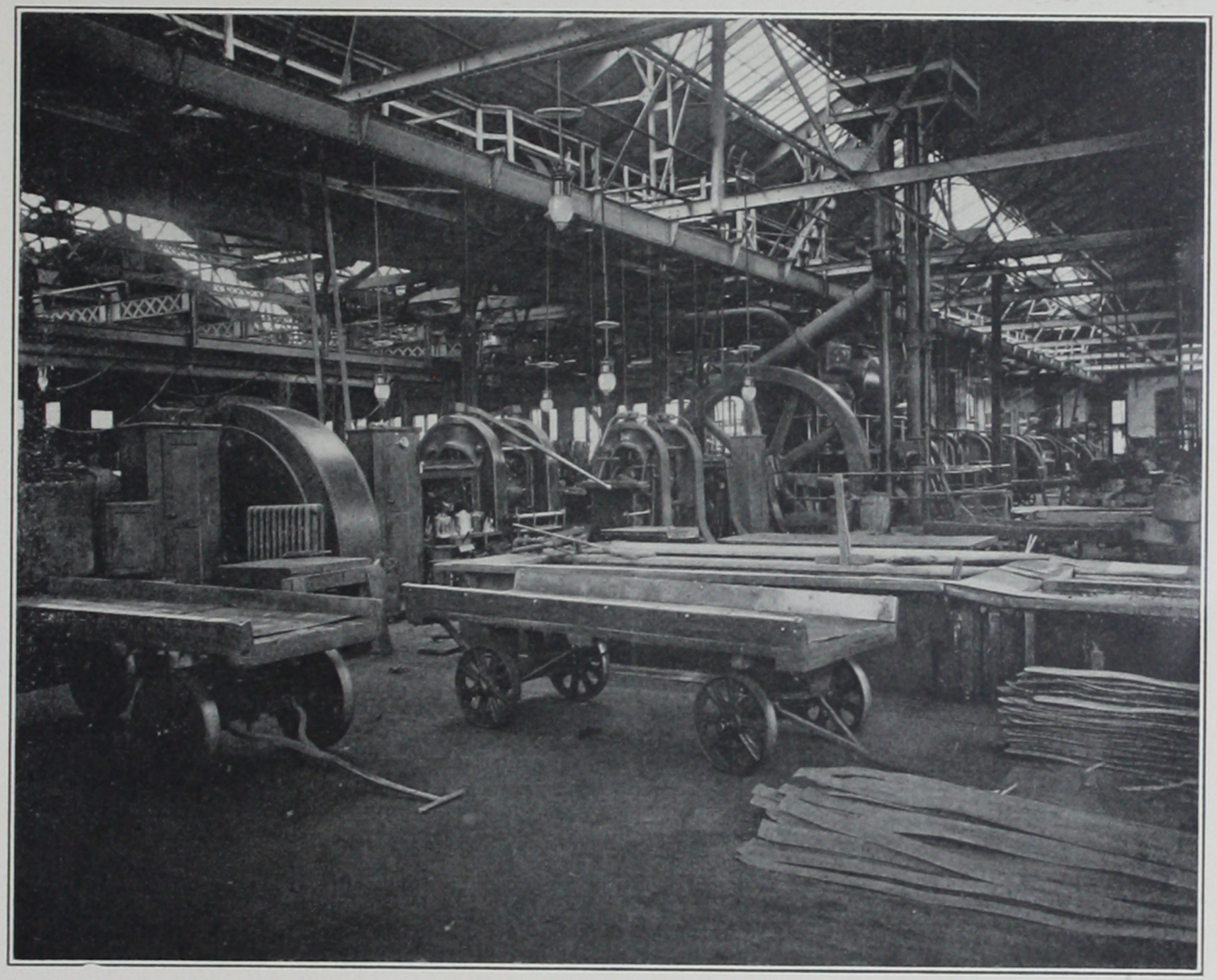
I. Making the Brass:
   (1) Mixtures.
   (2) Casting.



FOUNDRY AND CASTING DEPARTMENT

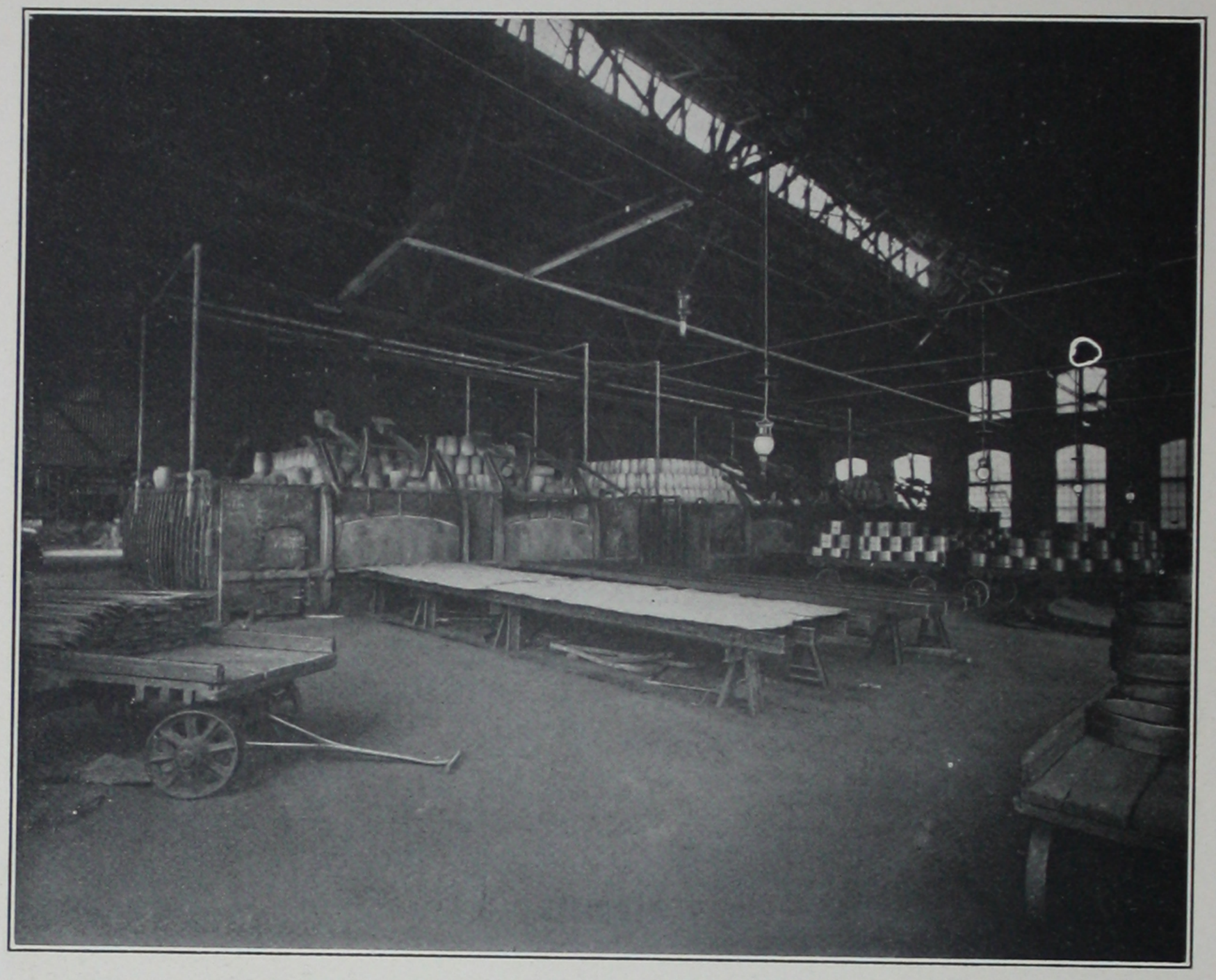
II. Rolling:
    (1) Breaking down.
    (2) Annealing.
    (3) Finishing.
    (4) Wire drawing.
III. Making the Parts:
    (1) Cutting and drawing.
    (2) Redrawing and annealing.
    (3) Edging and knurling.
    (4) Piercing and perforating.
    (5) Screw machine work.
    (6) Buffing, burnishing and polishing.
    (7) Dipping, cleaning and finishing.
IV. Assembling:
    (1) Assembling parts.
    (2) Inspecting and testing.
    (3) Lacquering.
    (4) Packing and shipping.
V. Miscellaneous.

It must be understood, however, that the above-named operations by no means comprise all that are necessary in making a complete burner. Each classification enumerated above could be subdivided many times, and merely to show how complex they are it is only necessary to say that the No. 71 burner is made up of 15 parts and has 163 separate and distinct operations put upon it and its parts **after the brass is made** and before the burner is ready for shipment. In fact, taking the extremes of simplicity and complexity in articles made for the Welsbach Company, it is well to compare, for example,



ROLLING MILL

the ordinary mantle support, which demands only two operations, (1) forming and (2) packing, with the No. 905 Indoor Arc Lamp, which contains 137 parts, comprising almost 1,000 operations. It must not be understood from this that a multiplicity of operations in manufacture necessarily makes an article complicated, for, paradoxical as it may seem, simplicity in the design and in the working parts of the finished article is often attained by the application of numerous and ingenious operations in the process of manufacture.



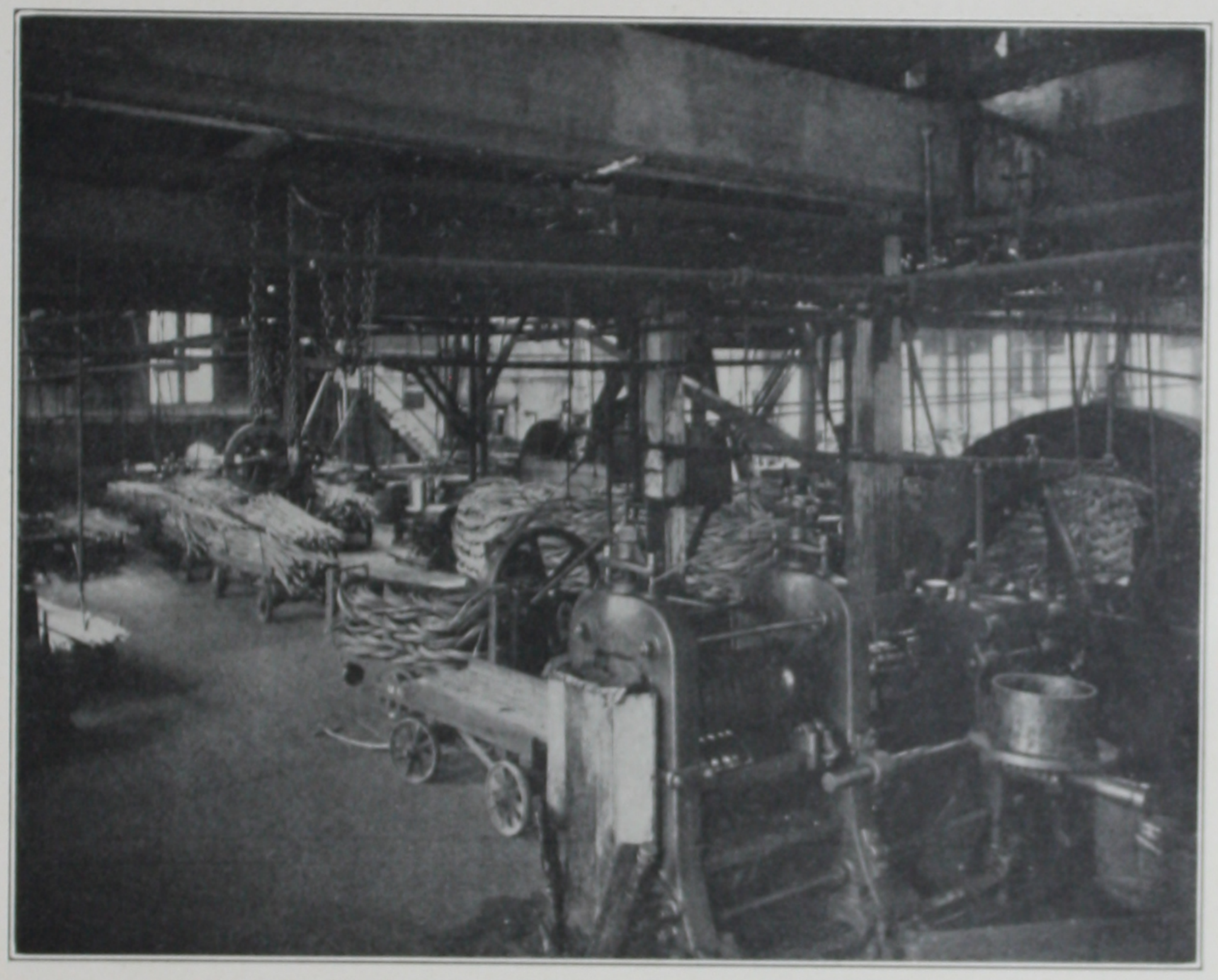
ANNEALING FURNACES-ROLLING MILL

MAKING THE BRASS. **Mixtures.**—The two metals chiefly used in making brass are copper and zinc. These can manifestly be mixed in many varying proportions, and with the addition of lead, nickel, manganese, tin, etc., each of which is used for a specific purpose, it becomes evident that the number of mixtures is almost without limit. Too much importance cannot be laid on the careful compounding of the mixtures, as an error of 1 per cent. or less in some elements will render the brass absolutely unfit for the intended purpose.

At the present time the Scovill Manufacturing Company uses almost two hundred different standard mixtures, each one of which has a definite result, either in the working qualities or color of the metal produced. By far the greater part of the brass used in a Welsbach burner is known as "High Brass," containing about two parts copper and one of zinc.

Casting.—The constituents to be used in making the brass are carefully weighed out and placed in large crucibles in the melting furnaces. After the

alloy becomes converted to the molten condition, the crucible is, by means of a traveling crane, swung over to the casting pits, where the contents are poured into a cast iron mould. If it is intended to use the brass for wire drawing, the moulds have a circular cross section, whereas if it is intended to be used in the rolling mills for the manufacture of sheet brass, the bars have a rectangular cross section. The size of these bars is regulated by the width of the sheet to be produced.



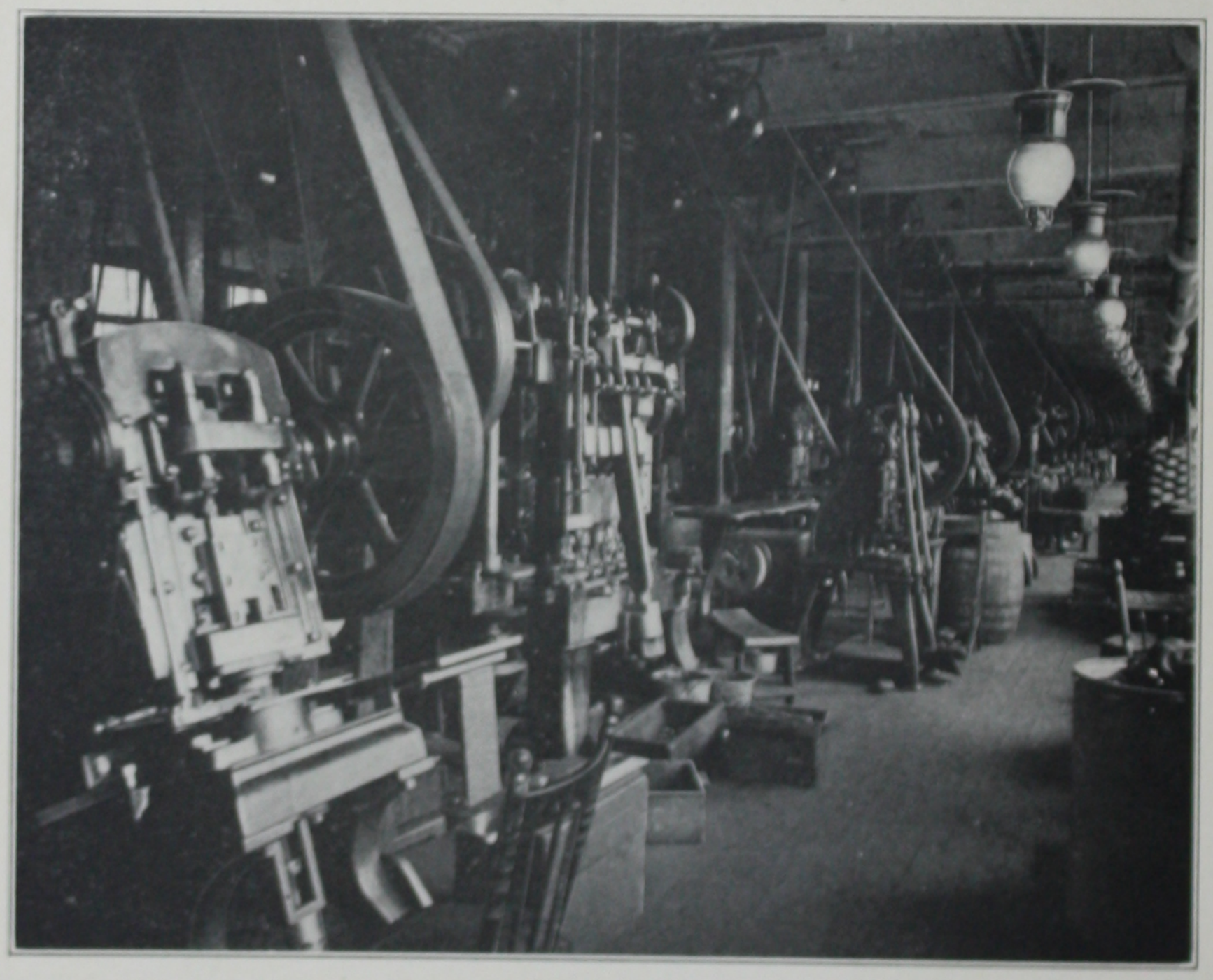
WIRE MILL

ROLLING. Breaking Down and Annealing.—The next few operations consist of successive rolling with annealing and pickling when necessary. It must be borne in mind that brass is cold rolled from the start. The amount of reduction in thickness during the first or "breaking down" operations depends entirely on how hard the brass may be allowed to become with safety to the metal itself and to the rolls, and right here is where the all-important annealing to soften the brass and subsequent pickling to remove the scale takes place. Any heat treatment must of necessity be very carefully

done and carefully watched, both in the casting and annealing. After the "breaking down" is done the metal, if intended for sheets, is reduced in thickness by many successive rollings. To convert a bar into sheets of .015 inch thickness requires about a dozen passes through the rolls, and at proper intervals it must be annealed and pickled four or five times.

Finishing.—The finishing pass, of course, gives the surface finish and the final thickness. It requires very careful adjustment and a high degree of skill to hold the thickness constant through the whole bar or sheet, yet this is done constantly with a variation of not over .001 inch. The degree of hardness desired in the finished metal must also be determined at this time; this is varied by the amount of reduction in thickness after the last annealing. After the last rolling the roll of sheet brass is run through slitting rolls to trim the edges and to get the exact width required.

Wire Drawing.—If the finished product from the mill is to be rod or wire instead of sheet, all the reductions after the "breaking down" are made by drawing through a wire die instead of rolling, otherwise the general process is the same.



CUTTING AND DRAWING BURNER PARTS

MAKING THE PARTS. The process of making tools for the numerous parts of a Welsbach burner is one demanding an extremely high degree of skill on the part of the toolmaker, and thereafter constant supervision and careful setting of the tools to see that they are at all times in condition to perform their several operations without error. Before attempting to make the tools a careful study is made of the model or drawing of the burner; it is thoroughly dissected and a complete set of opera-

EDGING AND KNURLING DEPARTMENT

tions laid out for each part. Then the actual tool making takes place and the size, grade, thickness and amount of metal necessary for each part are determined. Thus when the tools are ready every detail has been, as far as possible, previously determined and it is only necessary to start operations.

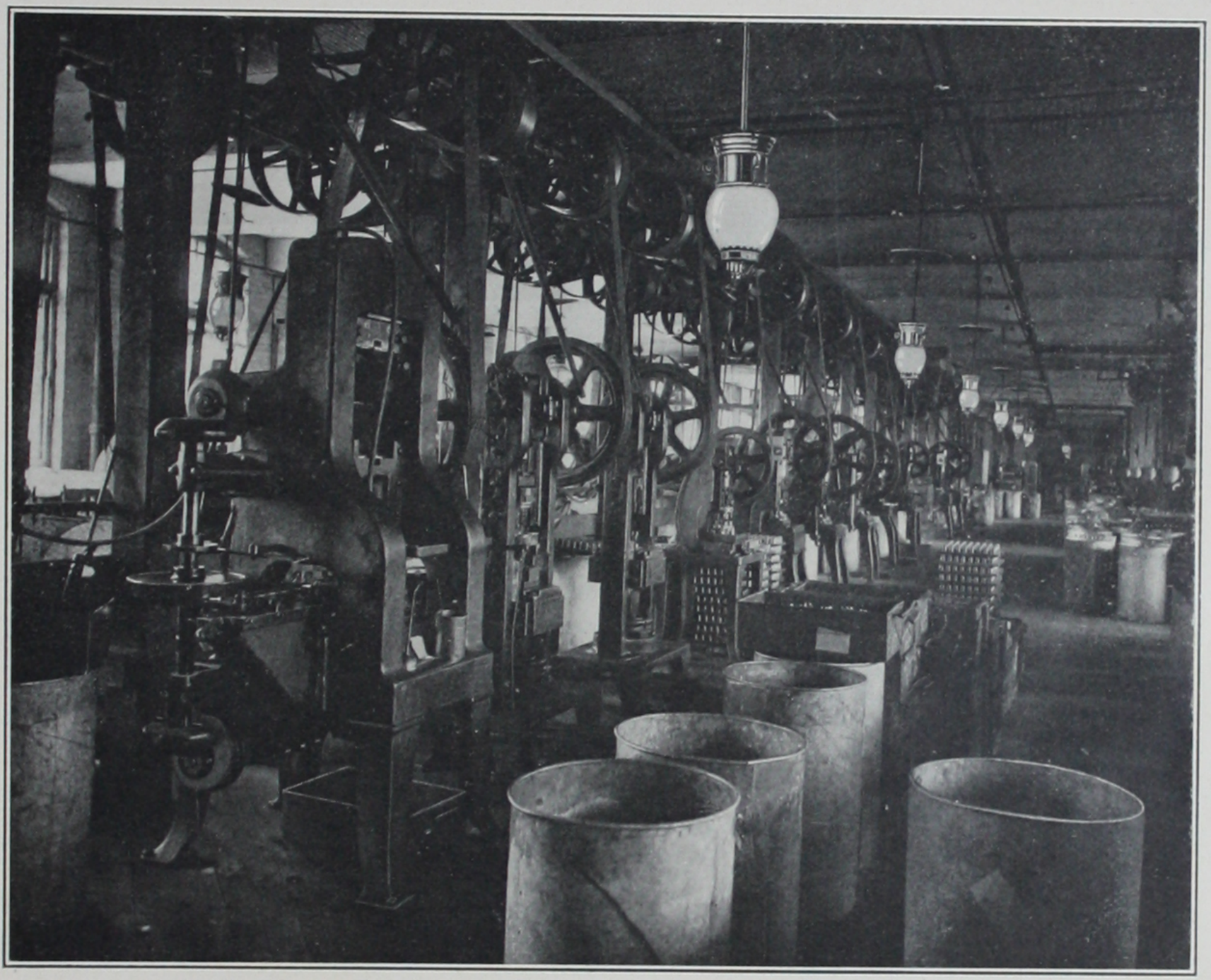
Cutting and Drawing.—Nearly all the parts comprising a complete burner are made from shells of predetermined size, and these shells are formed from sheet brass in one operation, known as cutting and drawing. A circular blank

PERFORATING PRESS ROOM

is cut from the sheet and formed into a cup at the same operation; this requires no further description except, perhaps, to state that often when the quantities involved are large, automatic presses are used, sometimes cutting the shells in "gangs," where several are made at each stroke, and sometimes in "multiple plunger" presses, where subsequent operations are combined with blanking and practically a finished part turned out by one machine.

Redrawing and Annealing.—The operations of redrawing are often many in number, as, starting with a shell of large diameter in comparison to height, many successive reductions are necessary to obtain a shell, such as a Bunsen tube, for example, which is many times as long as it is in diameter. Between these various operations the shell must be annealed to overcome the hardness imparted to the brass by the previous draft or pinch between the punch and die and pickled to remove the scale. In shells such as the skirt of a Welsbach burner these reworking operations are termed "stripping" instead of "drawing," this word being applied to an operation wherein the reduction in diam-

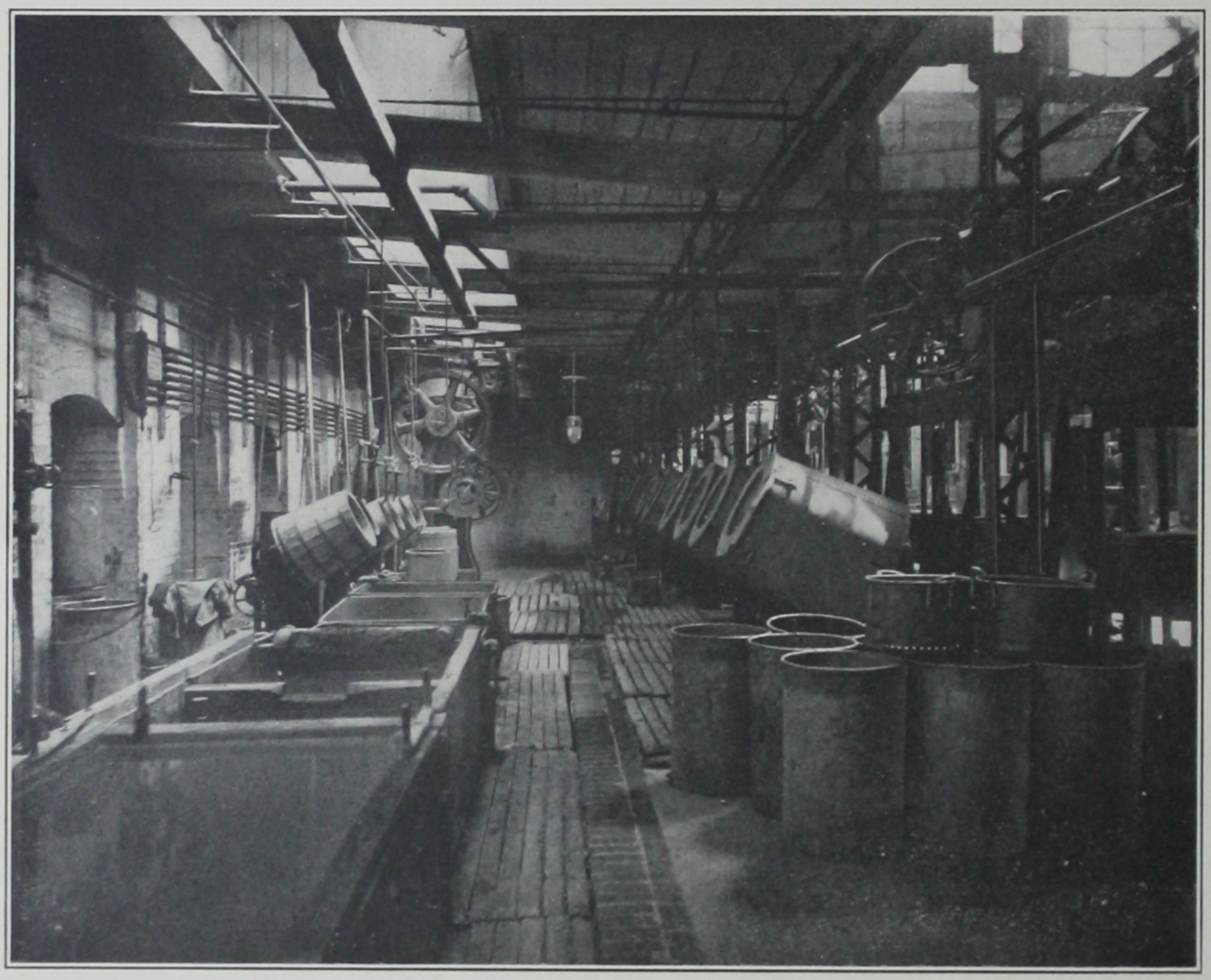
eter is not the same along the whole length of the shell; it might also be termed "shaping," and is often succeeded by a stamping operation for the final desired shape. Redrawing and stripping operations are performed in many types of presses, some with ordinary hand feed, others with various devices, automatic or semi-automatic in character, for feeding the shells.



POWER PRESSES FOR BUNSEN TUBES

Edging and Knurling.—After the drawing operations the shell is probably very ragged on the edges, owing to previous inequalities, and in order that it may be handled properly during the subsequent operations the edge must be trimmed uniformly. Except in the case of large shells this operation is done on automatic machines. At this time also the knurling is done, which operation also is known as spinning or beading. Its effect may be plainly seen on the mixing chamber as well as at the junction of the skirt and fence on the No. 71 burner. Lettering, when necessary, is also done at this time.

Piercing and Perforating.—The piercing in burner parts varies a great deal in its details, and hence tools are used which are often extremely simple in construction and operated in the ordinary small power press; and again the tools are quite complicated, as several holes may be pierced at once, or they may be designed for use in dial feed presses for economy in operation. A forming often is combined with a piercing operation—this is shown in the bottom of the No. 71 mixing chamber at the point where it is closed to the center tube.

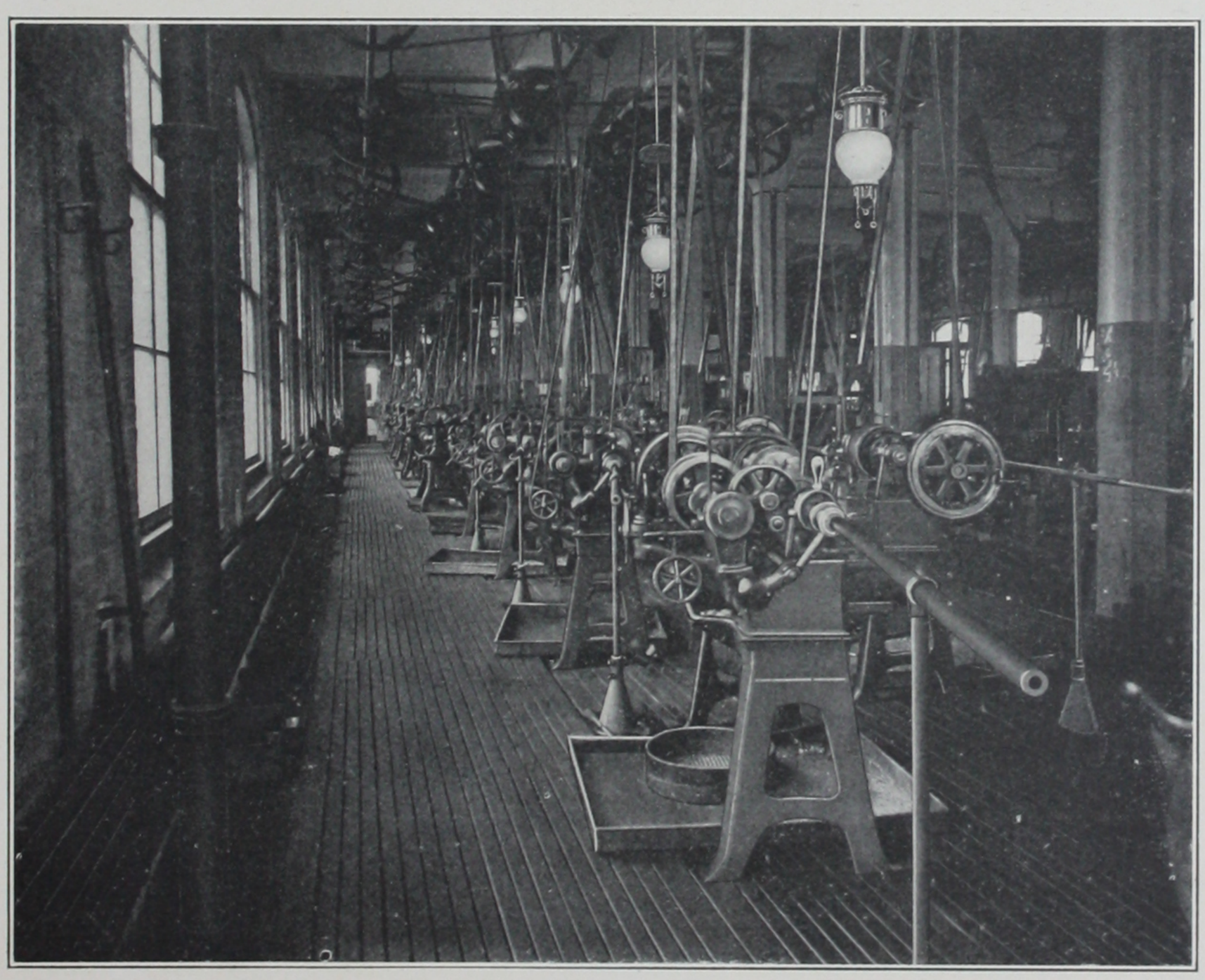


PICKLING AND TUMBLING DEPARTMENT

The operation termed "perforating" is in reality an elaborated piercing. A type of this may be seen on both the fence and skirt of the Welsbach burners. The tools for this work are operated by means of a ratchet mechanism timed to trip after making one circuit of the shell, and the design of perforation must, of course, be so dimensioned that it will be an exact factor of the circumference. Thus the operator, after placing the shell on the die, trips the

press and it rotates the shell exactly once by means of the pawl and ratchet, the interval of rest after each movement being sufficient to allow the punch to pierce the design.

Screw Machine Work.—It is well at this time to consider those parts which are made from rod instead of sheet metal. The part which illustrates this best is the Bunsen base of the No. 71 burner. This is formed entirely automatically on screw machines; it is only necessary for the operator, who runs several machines, to keep them supplied with rod—the machines do the rest. This comprises the first operation, the second being performed in a similar manner, though a different feeding mechanism must be added. In case the quantities involved are not large enough to warrant the large tool expense incident to fitting up a full automatic screw machine, the operations are performed on hand machines which are more or less automatic in action, though an operator is required for each machine.



AUTOMATIC SCREW MACHINES

ASSEMBLING BURNER PARTS

Buffing, Burnishing and Polishing.—Before the burner is assembled it is usually necessary to finish the surface of the metal by giving it the desired polish to serve as a basis for the final finish. This is done either by buffing, burnishing or tumbling. The former method is usually employed, and is applied in the ordinary manner with a cloth wheel and buffing composition, though automatic buffing machines are used whenever the quantity warrants. Burnishing is done by means of a highly polished tool and water; the resulting finish is not so soft in tone as a buffed surface, though for small pieces it is usually satisfactory. It also hardens the metal to a certain extent, which is often desirable.

After the burners are assembled it is necessary to "color" them. This operation is nothing more than a light buffing, and restores the highly polished appearance, which naturally becomes tarnished by repeated handling. In the case of parts made from steel, a porous condition of the metal is often apparent, and it becomes necessary before buffing to bring the metal to a good

surface by grinding, or polishing, as it is often termed, this being done by means of a fine emery wheel or strap.

Dipping, Cleaning and Finishing.—After buffing, or after an operation during which the work becomes oily or dirty, it is necessary to thoroughly clean the parts before the next step. The methods employed are varied, depending on the character of the work and kind of foreign substance to be removed. Some of the usual methods use baths of benzine, hot water and soap, or cyanide of potash as the cleaner. In other instances water rolling, sand rolling and other methods of tumbling are used to remove dirt and scale and to produce different finishes.

Closely allied with the cleaning operations are those of pickling, dipping, plating, oxidizing, bronzing, etc., which are used in many different ways and with many varying formulæ, but owing to lack of space it is impossible to give details in this pamphlet. At the present time, however, the Scovill Manufacturing Company is using about fifty standard finishes on burners and similar work.

ASSEMBLING BUNSEN TUBES

ASSEMBLING. **Assembling Parts.**—Upon examination the gallery portion of the Welsbach burner is seen to be made of four parts, fence, skirt, mixing chamber and center tube. The two former are buffed, the latter acid dipped. The assembling of these parts is done in either foot presses or small power presses, and, in fact, these are the only types of machines so far developed for this class of work. Each piece must be handled separately, and it is well that this is the case, as it introduces a cursory inspection by the press hand; and inasmuch as the parts have by this time had a considerable

TESTING BUNSEN TUBES

proportion of the total labor involved already put upon them, it becomes more necessary to handle and examine each piece to guard against errors which, if they were allowed to pass, might affect the finished product. Therefore, the inspection and assembling of the parts are closely allied at all stages of manufacture, many parts being carefully examined, piece by piece, before assembling. The flash diaphragm is assembled in much the same manner as the gallery, but the Bunsen is put together entirely by hand.

A detailed examination of the No. 61 or lever Bunsen, which is used in all of the high-grade Welsbach burners, shows the number of parts, and the fact that it is assembled by hand is at once evident. This Bunsen has had a steady development in all its parts, and special methods and machinery have been devised for its production and improvement. Three metals are employed in its construction—steel for the small tripod or "spider," which may be seen under the thimble; german silver for the lever, and brass for the remainder of the parts. It is necessary to have the "spider" stiff, hence the steel. Costly and detailed experiments have developed the use of german

LACQUERING DEPARTMENT

silver for the lever, and this has been one of the chief means of reducing original leakage and prolonging the serviceable life of this Bunsen. At present every Bunsen tube is carefully tested before it leaves the factory, and the average percentage of leaks is remarkably low—less than 1½ per cent. The most eloquent tribute to the success of the manufacture, workmanship

and design of this Bunsen tube is that six millions of them are made and sold annually. It is the most successful adjustable Bunsen ever made, and its sales aggregate several times that of all other Bunsen tubes in the market.

Inspecting and Testing.—The final inspecting and testing of these Bunsens is done in a darkened room, so that leaks, however minute, may be at once detected. A special gas compressor and regulator is used, so that the gas pressure is at all times uniform. In addition to testing for leaks the jet of

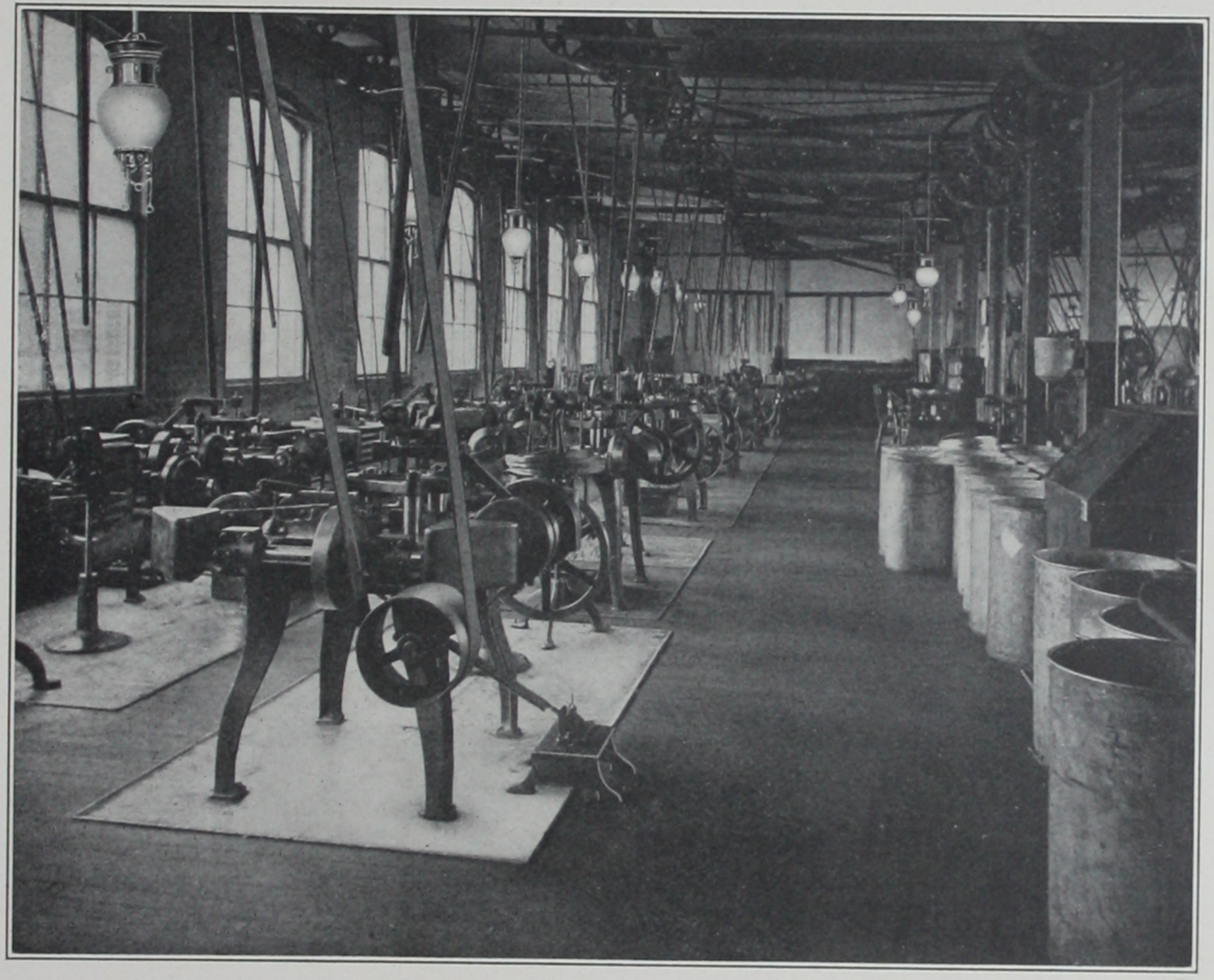
PACKING DEPARTMENT

gas issuing from the center hole must be absolutely central, for should this jet or those from the auxiliary holes impinge on the sides of the tube, a decrease in efficiency is always the result.

The inspections of the parts and of the assembled burner are probably the most carefully watched operations in the whole assembling process. This is almost entirely a question of the inspector's ability and reliability, and for this reason the operators employed on this class of work must be very carefully

chosen and supervised. Construction, finish and general appearance of the burner must all be taken into consideration, and, as a matter of fact, it would not be surprising if these three qualifications did not also apply to inspector as well as to the inspected work.

Lacquering.—Before the final inspection, and in many instances before the final assembling is done, the finish must be covered with lacquer to prevent tarnishing. This is an important operation which is altogether too often slighted by manufacturers. The Scovill Manufacturing Company makes its own lacquers from the purest ingredients obtainable, and the results are



MACHINES FOR FORMING MANTLE SUPPORTS

always uniform and lasting. Compare a Welsbach burner with almost any other, and the difference in finish and appearance is at once apparent. Lacquer is applied in several ways. The article may be dipped in a bath of lacquer, the lacquer may be sprayed on the article, or it may be brushed on, either by hand or by automatic machines.

Packing and Shipping.—No detailed description of the method of packing seems necessary—the unpacking by the customer will show this—but it is well to note that the burners get at this time another and final inspection before being wrapped. The work demands a high class of labor to insure the best efficiency.

MISCELLANEOUS. No mention has been made in the preceding pages of the manufacture of the screws and rivets used in the Welsbach burners and lamps. The Scovill Manufacturing Company has a special department devoted solely to this class of work, with a capacity of over two millions per day of these articles. All sizes are made, from rivets so small that several hundred can be held in the palm of one's hand up to steel cap screws an inch in diameter. Specially designed machinery is used entirely for this work, all threads being **rolled—not cut.** By this method a very much superior product is obtained, a much more uniform output is maintained, and it is possible to hold the screws much closer to gauge than by cutting by means of a die.

CONCLUSION. The importance of high class work cannot be insisted on too strongly. Almost every user of incandescent burners, and certainly every dealer, is aware of the numerous cheap affairs that are on the market. It may be assumed that the importance of using high class mantles is patent if ultimate economy is desired, and not only economy in use but finish and high grade workmanship are the keystones of the success of the Welsbach burner of to-day. These burners are not designed merely to sell on their appearance, but also on their efficiency. What degree of extravagance is involved in buying a low grade burner which uses twice as much gas per hour as the better grade of Welsbach burners?

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